

Announcements

□ Homework for tomorrow...

Ch. 22, CQ 2, Probs. 10, 12, & 14

CQ3: before

CQ7: $A = 4 \text{ cm}$, $\lambda = 12 \text{ m}$, $f = 2.0 \text{ Hz}$

20.20: a) $3.2 \times 10^{-3} \text{ m}$ b) $9.4 \times 10^{10} \text{ Hz}$

20.24: a) $1.0 \times 10^{10} \text{ Hz}$ b) $1.6 \times 10^{-4} \text{ s}$

20.26: a) $8.6 \times 10^8 \text{ Hz}$ b) 0.23 m

□ Office hours...

MW 10-11 am

TR 9-10 am

F 12-1 pm

□ Tutorial Learning Center (TLC) hours:

MTWR 8-6 pm

F 8-11 am, 2-5 pm

Su 1-5 pm

Chapter 22

Wave Optics

*(The Interference of Light &
The Diffraction Grating)*

Last time...

- Angular position of m^{th} bright fringe...

$$\theta_m = m \frac{\lambda}{d}, \quad m = 0, 1, 2, 3, \dots$$

- Position of m^{th} bright fringe...

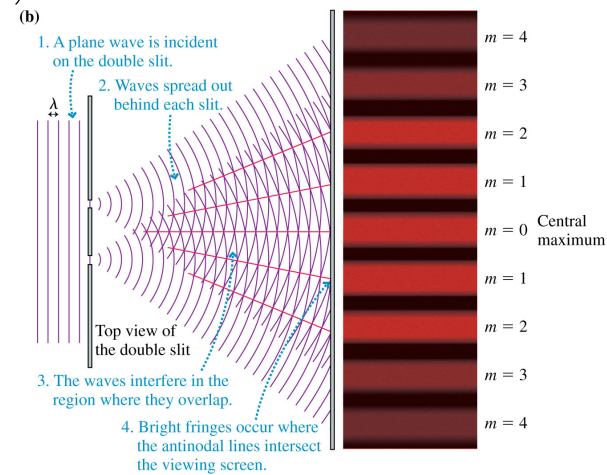
$$y_m = \frac{m\lambda L}{d}, \quad m = 0, 1, 2, 3, \dots$$

- Fringe spacing...

$$\Delta y = \frac{\lambda L}{d}$$

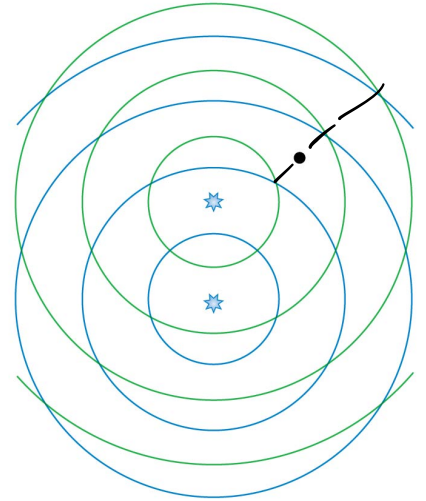
- Position of m^{th} dark fringe...

$$y'_m = \left(m + \frac{1}{2}\right) \frac{\lambda L}{d}$$



Quiz Question 1

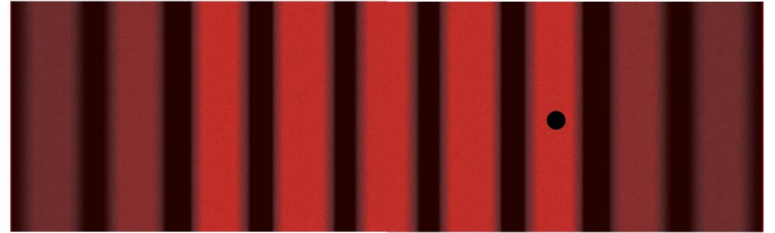
Two rocks are simultaneously dropped into a pond, creating the ripples shown. The lines are the wave crests. As they overlap, the ripples interfere. At the point marked with a dot,



- ① The interference is constructive.
2. The interference is destructive.
3. The interference is somewhere between constructive and destructive.
4. There's not enough information to tell about the interference.

Quiz Question 2

A laboratory experiment produces a double-slit interference pattern on a screen. The point on the screen marked with a dot is how much farther from the left slit than from the right slit?



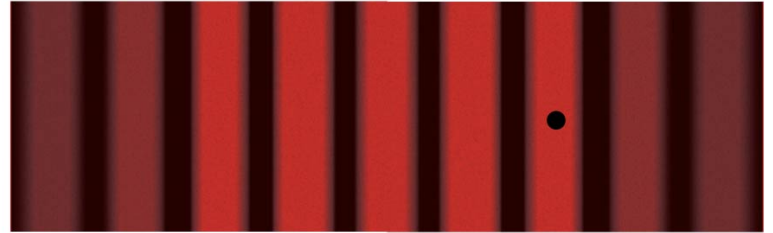
Central maximum

1. 1.0λ .
2. 1.5λ .
3. 2.0λ .
4. 2.5λ .
5. 3.0λ .

Quiz Question 3

A laboratory experiment produces a double-slit interference pattern on a screen. If the screen is moved farther away from the slits, the fringes will be

$$\Delta y = \frac{n\lambda L}{d}$$

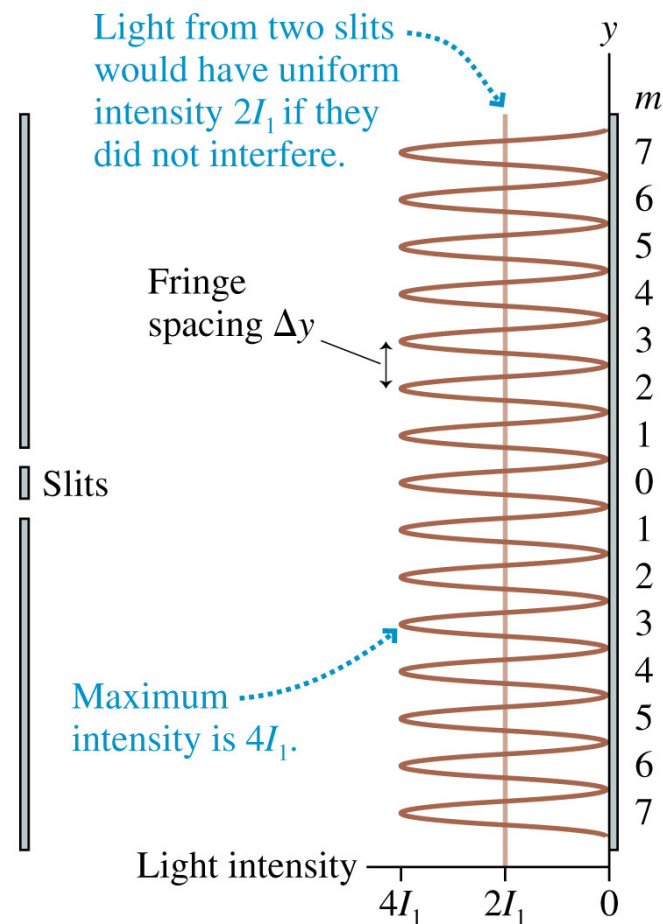


Central maximum

1. closer together.
2. in the same positions.
3. farther apart.
4. fuzzy and out of focus.

Intensity of the Double-Slit Interference Pattern

- If there were NO *interference*, the light intensity due to two slits would be *twice* the intensity of one slit ($2I_1$).
- Instead, the superposition of the 2 waves creates *bright* and *dark fringes*.
- What is the *intensity* of the double-slit interference pattern at position y ?



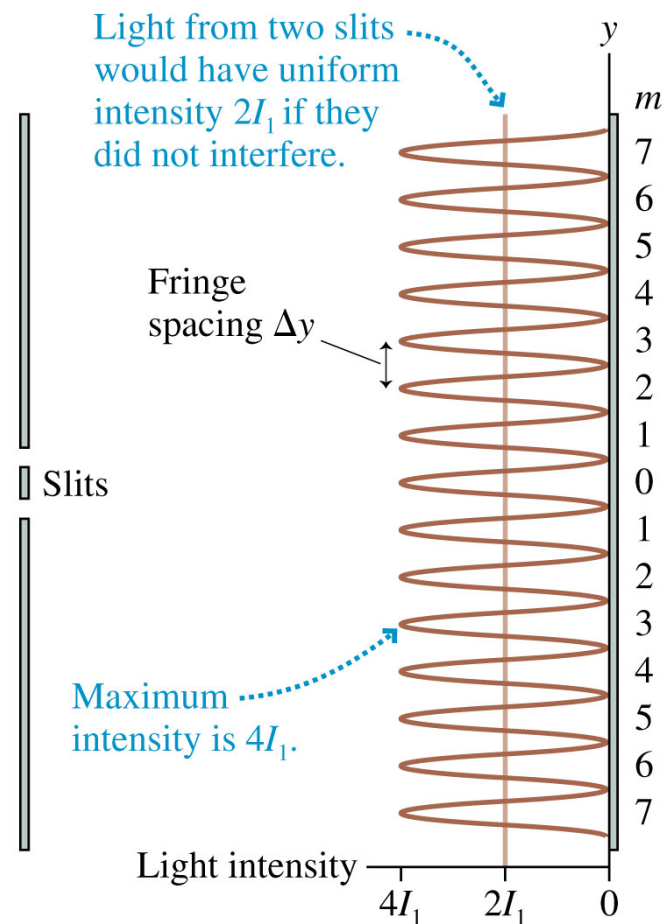
Intensity of the Double-Slit Interference Pattern

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$$I_{double} = 4I_1 \cos^2 \left(\frac{\pi d}{\lambda L} y \right)$$

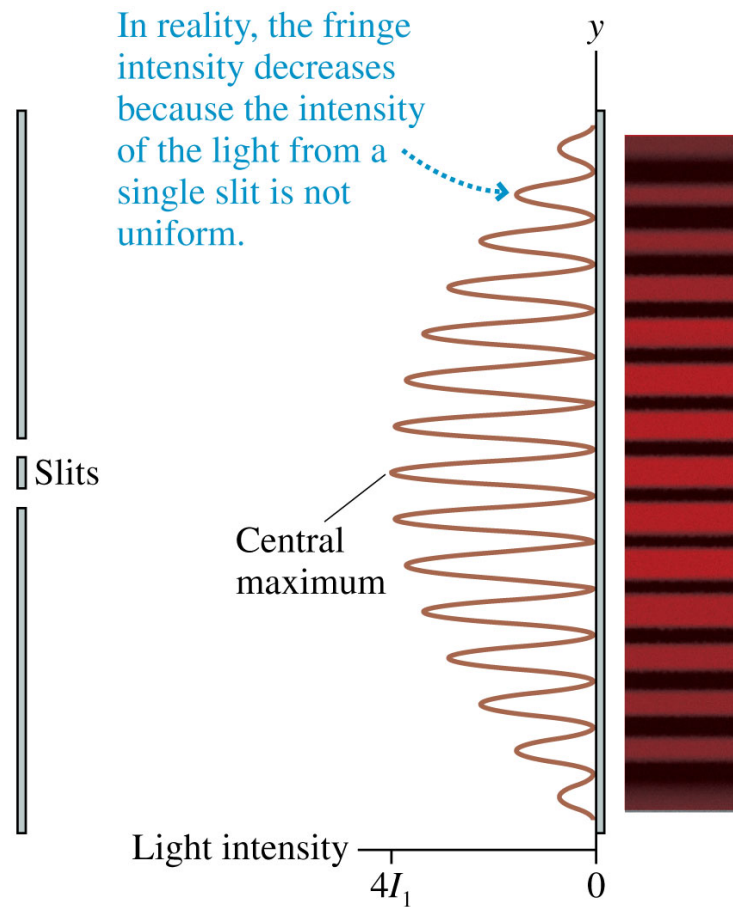
Notice:

Intensity oscillates between 0 and $4I_1$.



Intensity of the Double-Slit Interference Pattern

The actual intensity from a double-slit experiment slowly *decreases* as $|y|$ increases.



Quiz Question 4

A laboratory experiment produces a double-slit interference pattern on a screen. If the *amplitude* of the light wave is *doubled*, the *intensity* of the central maximum will increase by a factor of



Central maximum

1. $\sqrt{2}$.
2. 2.
3. 4.
4. 8.

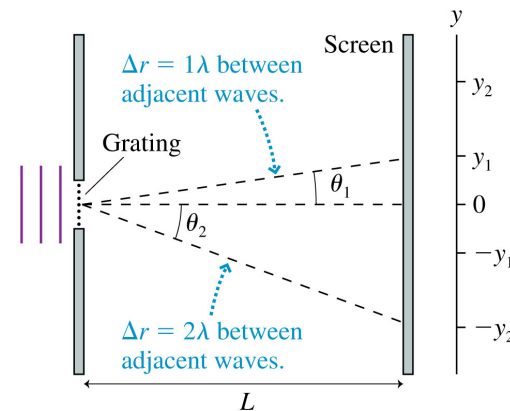
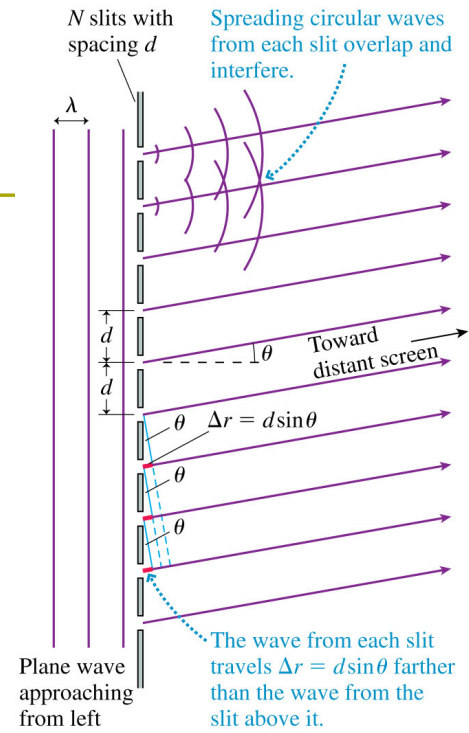
22.3

The Diffraction Grating

- The figure shows a *diffraction grating* in which N slits are equally spaced a distance d apart.
- Only 10 slits are shown here, but a practical grating will have hundreds or thousands of slits.

What are the *angular positions* of the *bright fringes* in the interference pattern?

Where does the m^{th} *bright fringe* occur?



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What are the *angular positions* of the *bright fringes* in the interference pattern?

$$d \sin \theta_m = m\lambda, \quad m = 0, 1, 2, \dots$$

Where does the m^{th} *bright fringe* occur?

$$y_m = L \tan \theta_m, \quad m = 0, 1, 2, \dots$$

